Flowing Atmospheric Pressure Afterglow (FAPA) Ionisation Source to Extend the Capability of an Orbitrap MS

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Introduction

A glow discharge is maintained between two electrodes via a high voltage power supply and helium gas. Helium metastable atoms react with atmospheric constituents through complex reactions to form protonated water clusters; through further reactions these reagent ions ionise the sample in the afterglow region. Species are directly desorbed and ionised from the sample surface. The FAPA ionisation source was introduced by Hieftje et al. in 2008. Various designs have been produced. In this study two pin-to-capillary FAPA sources have been developed based on a design by Shelley et al.

AIM: Develop an alternative ionisation source for the National Mass Spectrometry Facility (NMSF) to extend analytical capability.

Methods

Instrument used: Thermo Fisher Scientific LTQ Orbitrap XL (Thermo Fisher Scientific Inc., CA, USA) fitted with an Atmospheric Pressure Solids Analysis (ASAP) probe. A glass melting tube is used to deposit the sample, the glass tube is placed inside a sample probe which is inserted into the side of the ion max source into the afterglow discharge. A reagent such as ammonium acetate (NH₄Ac) (common additive for protonation) can be added to the sample tube to aid ionisation (analist’s discretion). All analyses were carried out in positive ionisation mode. Data acquisition and processing was achieved using Xcalibur (v2.0.7).

Results

Prototype I

 Prototype II

Prototype I showed analyte ions could be observed at various inter-electrode gaps, helium pressures, and currents. For routine use Prototype I was not stable enough in operation. A machineable robust design was developed which has the potential to fit into a Thermo Ion Max API source housing.

Prototype II Spectra

A variety of analytes of different molecular weights can be successfully ionised by FAPA with strong signal intensities (NLEI) obtained. Off-axis fixing of the FAPA gun to the MS inlet shows lower signal intensities compared to on axis fixing; hence initial studies have used horizontal (on-axis) positioning. Increasing the glow current and inter-electrode gap appears to be more suited for analytes of higher molecular weight and vice versa. The positioning of the sample in between the FAPA afterglow and MS inlet is important to achieve good sensitivity. Future work will involve optimising various parameters of the FAPA gun (inter-electrode gap, Helium flow, current, angle of ionisation, sample position in front of the afterglow). FAPA will also be compared to other ionisation techniques such as ASAP and Electron Ionisation [63].

Conclusion

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